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University of the Philippines

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RICE CULTURE IN ITALY AND SPAIN [1]

ANDRES P. AGLIBUT

ITALY

Experimental Station of Rice-Growing

The Rice Experiment Station in Vercelli, Italy, officially called "Experiment Station of Rice-Growing," was established in 1908 by the Farmers' Association of Novara and Vercelli and the Irrigation Association of the region west of the Sesia River in the Po Valley. The Station was incorporated in 1911 and syndicated in 1918. Experiments on several phases of rice production have been conducted in the Station since 1929.

The administrative offices and the chemical, milling, and processing and utilization laboratories are located in Vercelli City proper. Three miles away from the city are the field station offices, genetics and fish culture laboratories, and rice experimental plots and fields. The 38-hectare field station has 25 hectares for experimental rice culture.

The station has five sections, namely, agriculture, mechanics and irrigation, seed or genetics, chemistry and industries, and fish culture. The chemical and industrial section is equipped with modern laboratory facilities. The seed (genetics) section has a vast world-wide collection of important rice varieties. The Philippines has two or three varieties in the collection.

Most of the staff are in the government service but some of the employees are paid by the Station. The Board of Agriculture of the State controls the technical activities of the Station.

Many valuable scientific contributions for the improvement of Italian rice culture have been made by this research station since its establishment. These contributions include improved fertiliza-

[1] General Contribution No. 888. Portion of the author's report on his observations of rice irrigation research and culture and on his conferences with Rice Experiment Station officials in his trip through different rice-producing countries sponsored by the Rockefeller Foundation. The author gratefully acknowledges the assistance extended to him by the Foundation and the Directors of Vercelli Rice Experiment Station, Vercelli, Italy, and Sueca Rice Experiment Station, Valencia, Spain.

tion and manuring of rice fields, creation of new types of rice, mechanical threshing, drying and milling, use of rice flour with wheat flour for making bread and paste, utilization of rice by-products, better irrigation and drainage practices, and development of mechanical equipment for rice research laboratories and rice cultural operations. The Station has also enabled students or researchers to undertake research work for advanced degrees.

Rice-Producing Areas

In 1952 there were two regions in Italy where rice was produced on an extensive scale In Piemonte, the total area planted to rice in 1953 was 86,333 hectares. In this region there were two out of three provinces that were considered commercial producers of rice, namely, Vercelli, 59,570 hectares, and Novara, 22,978 hectares. The average yields per hectare in these provinces were 48 quintals (109.1 cavans) and 53.7 quintals (121.1 cavans), respectively.

In Lombardia, the total area planted to rice in 1953 was 72,195 hectares. In this region two out of six provinces had also extensive areas cropped to rice, Pavia (49,879 hectares) and Milan (17,952 hectares). Four other provinces in the region produced rice on only 4,364 hectares. The average production per hectare was 50 quintals (113.6 cavans) in Pavia and 46 quintals (104.5 cavans) in Milan.

In the Bologna province, there were only 2,973 hectares planted to rice in 1953, but this area is well known in the rice world for its yield of 68 quintals (154.5 cavans) per hectare. In Italy, the total area in rice production in 1953 was 174,053 hectares, and the average yield was 49.6 quintals (112.7 cavans) per hectare.

Rice Culture

Land preparation. Mechanical power is used for plowing the land dry. After plowing water is introduced to soak the rough, plowed ground. A leveler attached behind a tractor is then used to break the clods and level the surface. Puddling and harrowing by animal or mechanical power put the field in final condition for transplanting. These operations follow one another in sequence, but sufficient time between them is allowed to permit complete rotting of the previous crop residue before it is finally incorporated as organic matter in the soil.

Methods of planting. In Italy, lowland rice is planted by broadcasting and drilling, and transplanting. About 60 per cent of the total rice area in the Po River valley around Vercelli was planted by broadcasting and drilling, and about 40 per cent, by transplanting. Of the broadcasted area, 50 to 55 per cent was hand-broadcasted and 45 to 50 per cent, machine-broadcasted and drilled. Transplanting the seedlings, which are usually 45 to 60 days old, depending upon the variety, is performed mostly by mechanical transplanters but some farmers who cannot avail themselves of the equipment still practise transplanting by hand labor.

Transplanting is generally done with the field submerged in water 10 to 15 centimeters deep. The seeds are soaked before broadcasting, which is usually done in late April or early May.

Weeding rice fields. Weeding is a standard field operation in rice growing. The high rice yield in the country is due partly to thorough weeding. Transplanted fields are weeded once or twice in June, but fields that are broadcast-planted generally receive three weedings, the first being done in the early part of June. Weeding may be by hand or animal labor. In the latter method, an animal-drawn cultivator weeder cultivates and simultaneously uproots the weeds between the rows. Cost of weeding broadcast-planted fields is about ₱160 per hectare for three weedings on the average. Weeding transplanted fields, therefore, costs much lower on account of less weed density, an effect of good control of water and the headstart of the transplants over weeds.

Method of irrigation used. In the rice area around Vercelli, the fields are submerged to a depth of about 15 centimeters from transplanting and drained twice before maturity. The depth of water is varied up to 20 centimeters primarily for weed control, but in the absence of weeds, it is kept at 10 to 15 centimeters. Drainage promotes better aeration of the soil and deeper penetration of the plant roots. The first drainage lasting four to five days takes place about 25 days after planting to hasten plant development. The second, lasting just as long and sometimes a few days longer, takes place after the last weeding in June, when ammonium sulfate fertilizer dressing is applied.

Irrigation and Drainage Important

The production of rice in Italy depends upon adequate water supply, its proper distribution, and application and removal if de-

sired. For the valley between the Po River and Sesia River where most of the rice is grown in this part of Italy, irrigation water is diverted from the Po and Dora Batea Rivers. The biggest of the main canals which is the Cavour Canal passes through 25 miles west of Vercelli. Lined with concrete, the canal has check gates, turn-ins, turn-outs, junction boxes and water-measuring structures which enable thorough control and proper regulation of water at all times. The extensive use of irrigation water and its proper distribution and removal when desired are clearly evidenced by the presence of structures and the network of irrigation and drainage canals criss-crossing the rice areas.

Irrigation Associations and Districts

The irrigation system in Vercelli, almost entirely of gravity type, is administered by an irrigation association called 'Associazone Irrigazione O-vest Sesia-Vercelli", which is over a hundred years old. There is a similar irrigation association in Novara province. In 1955, 24,000 farmer members were registered. The association is divided into branches, called irrigation districts, each of which is administered by a council composed of representatives of the landowners.

Operation of an Irrigation District

Information obtained from the Office of the Trino Irrigation District revealed that the district had 700 farmer members the previous year, served a total area of 2,600 hectares, of which 1,880 hectares were planted to rice, 350 hectares to permanent forage crops, and the rest to corn and wheat. The staff was composed of a chief of administration, a secretary and 19 water tenders. The first two officers work throughout the year, and the water tenders, for six months.

The average water requirement of the entire district was five cubic meters per second for all irrigated crops. Rice required one liter per hectare per second for evapo-transpiration, but the average gross irrigation requirement is five liters per second per hectare which is very high compared with that used in other rice-producing countries. This is because the water is kept in continuous flow from the higher to the lower paddies, and in order to maintain the 20-centimeter depth in the paddies the outflow must equal the inflow minus the evapo-transpiration, percolation and seepage. Also,

the percolation in the Vercelli rice fields is relatively high. The relative use of water by the different irrigated crops within the district was seven for rice, three for forage crops, one for other crops like corn, onion, etc.

The average yields per hectare of the irrigated crops were: rice, 52 quintals (a quintal equals 100 kilograms); forage crop, 125 quintals of dry matter; wheat, 30 quintals, and corn, 43 quintals. Wheat, however, was occasionally irrigated.

The charges for the use of irrigation water in the district were on the hectare basis per year. And although water was always available as desired, its delivery to the different users was controlled by the water tenders. The schedule of charges to a hectare per year was: rice, ₱39.65; forage crops, ₱24.96; other crops, ₱12.16. These charges are high compared with those in other countries (₱12.00 to a hectare per year in the Philippines).

The total annual expenses for water of the Irrigation District amounted to ₱25,000; for maintenance of canal system and operation of four pumps, the figure reached ₱35,600; and salaries and wages of personnel, ₱28,000. The cost of four motor-driven pumps is included because these pumps that elevate water from the lower to the high canals for the irrigation of fields on higher elevation belong to the district.

Other services that the district renders to the farmer members include giving information on the condition (turbidity, silt content and temperature) of water, daily depth of the water in all sections of the canal system, depth or quantity of water needed by the different crops for every irrigation, and good method of irrigation to follow. If these services could be rendered by the irrigation systems in the Philippines, in addition to their present sphere of activities, it would be possible to increase the benefits that the country derives from the use of irrigation water. This would be integrating the activities in the engineering, agricultural, and socio-economic phases of irrigation for the attainment of more productive operations of our systems.

Crop Rotation, a Common Practice

In the rice region around Vercelli,[2] rotation includes wheat in the first year; grass or red clover for pasture in the second; trans-

[2] D. H. Grist, "Rice," London, Longmans, Green and Co., 1955, 333 p.

planted rice in the third; and broadcasted rice in the fourth and fifth years. In between the third and fourth years or fourth and fifth years, some farmers plant green manure crop. Another system of cropping followed by some Vercelli farmers is as follows: a crop of wheat or oats in the first year, followed by one or two years of pasture, and three to four years of rice. Longer rotations are often practised, which include a crop of cereal (wheat, rye or corn) in the first year, followed by three years of pasture, again, wheat, rye or corn in the fifth year, and three annual crops of rice. A four-year schedule of successive cropping and pasturing also followed includes corn in the first year, wheat or oats in the second, pasture in the third, and rice in the fourth year. From the foregoing rotation practised by the Italian rice farmer in the Po Valley, it is evident that pasturage is always included in one or more years. Crop rotation explains the presence of diversified crops planted simultaneously in fields adjacent to rice, an admirable picture of the system of profitable farming followed by the Italian rice farmers.

Why Italy Has High Yield of Rice

Italy has high yield per unit area of rice, because of (1) the use of good seeds of high yielding varieties; (2) the use of rice varieties responsive to heavy fertilization; (3) adequate irrigation water, its proper distribution and application in the fields when needed, and timely drainage; (4) the long, shiny, warm days during the growing season; (5) thorough weeding of the fields; (6) crop rotation; (7) effective control of pests and diseases; (8) good land preparation; (9) rice production undertaken as a farm business which gives profit to the Italian industrious farmer; and (10) the adaptability of soil and geographical location for rice production.

SPAIN

Rice-Producing Provinces of Spain

Rice is an important food and export crop of Spain. In acreage, it ranks second to Italy. Rice is grown principally in 15 provinces, but most of the area planted and the rice growers are in the provinces of Valencia and Tarragona. The following table shows the area planted in 1954 and 1955 and the total and average yields per hectare for those years.

Rice area and yield of milled rice by province in Spain [a]

PROVINCE	AREA PLANTED IN HECTARES		YIELD OF RICE, TONS		AVERAGE YIELD, TONS PER HA.	
	1954	1955	1954	1955	1954	1955
Albacate	221.53	146.45	792	659	3.575	4.499
Alicante	703.88	710.28	3,017	3,196	4.286	4.500
Badajoz	365.90	371.99	2,667	2,120	7.291	5.700
Cadiz	222.00	213.50	1,465	1,601	6.595	7.499
Castellon	1,553.70	1,553.08	8,392	7,454	5.401	4.800
Ciudad Real	231.50	140.00	1,716	924	7.411	6.600
Gerona	1,326.09	1,068.62	7,060	3,847	5.234	3.600
Huesca	2,117.45	1,138.49	7,046	5,464	3.380	4.800
Lerida	1,047.95	798.66	4,191	3,833	4.000	4.800
Murcia	248.48	223.76	1,266	1,007	5.095	4.500
Sevilla	11,196.49	9,934.00	53,191	65,422	4.750	6.586
Tarragona	16,841.36	16,841.04	63,881	77,344	3.790	4.600
Valencia	27,059.77	26,643.50	194,555	175,847	7.190	6.600
Zaragoza	2,219.58	1,539.96	9,954	7,391	4.485	4.800
Total	65,482.25	61,392.54	350,800	356,513	5.342	5.807

[a] Data furnished by Director Jose Oyanguren of Sueca Rice Experiment Station, Valencia.

The foregoing table shows that the national average total area planted in 1954 and 1955 was 63,437.39 hectares, with an average total production of 353,536.56 tons of milled rice. These figures give an average yield of 5.575 tons (99.55 cavans) per hectare for the two years. The table also shows that the three provinces, Valencia, Tarragona and Sevilla, had a total rice hectarage of about 84 per cent of the country's total area in 1954 and 87 per cent in 1955. These provinces produced about 89 per cent of the country's total production in 1954 and 1955. According to Director Oyanguren, rice culture in Valencia had been undertaken since the time of the Arabs. The rice regions in Valencia are considered ideal for rice culture due to the humid and relatively warm climate. The fertile lands, availability of irrigation water from Lake Albufera, and the relative absence of rice pests and diseases also make the province suited to rice production.

Size of Rice Farms

A study of the size of rice farms and their distribution was made on the basis of the figures given by Director Oyanguren. The table which follows shows that 22,060 farmers or about 46 per cent of all rice growers, cultivated not more than one-third of a hectare each, and about 95 per cent of all farmers had rice farms ranging in size

from less than one-third to three hectares. However, the highest percentage (30.47) of the total area was in the one-to-three-hectare group. The small size of rice landholdings is conducive to intensive cultivation and results in high yield per unit area.

Size of rice farms in Spain, 1954 and 1955 [a]

SIZE OF FARM	NUMBER OF FARMERS	PER CENT OF TOTAL FARMERS	PER CENT OF TOTAL AREA
Not more than ⅓ ha.	22,060	45.97	8.92
More than ⅓ to ⅔ ha.	9,938	20.71	10.63
More than ⅔ to 1 ha.	5,000	10.42	8.95
More than 1 to 3 ha.	8,432	17.57	30.47
More than 3 to 5 ha.	1,573	3.28	12.67
More than 5 to 10 ha.	708	1.48	10.15
More than 10 to 50 ha.	259	0.54	9.73
More than 50 to 100 ha	6	0.01	0.95
More than 100 ha.	11	0.02	7.53
Total	47,986	100.00	100.00

[a] Data furnished by Director Jose Oyanguren of Sueca Rice Experiment Station, Valencia.

The foregoing table shows that few rice farmers cultivate more than 10 hectares each. In the province of Valencia in 1955, there were 32,891 rice farmers cultivating an area of about 26,644 hectares, or less than one hectare per farmer.

Method of Rice Culture [3]

Preparing and seeding the beds. Since rice culture in Spain is mostly by transplanting, two sets of preparing the land are practised. The first requires the preparation of the seedbeds by plowing the land dry with horse-drawn moldboard plow and later harrowing after flooding the fields. Seedbeds are surrounded with the usual earth dikes to hold the water during the growth of the seedlings. After the beds are thoroughly prepared and leveled, they are submerged with slowly-moving water before the pre-soaked seeds are broadcast. The seeds are soaked for 24 hours before sowing them in the submerged bed. The seedlings are generally grown in the beds from 50 to 60 days before they are ready for transplanting.

Preparing the fields. The fields are plowed dry with the use of tractors with three bottom moldboard plows. After plowing, the

[3] Director Jose Oyanguren of Sueca Rice Experiment Station, Valencia, was very helpful in supplying much of the data.

fields are flooded and harrowed thoroughly by tractors with rear wheel attachments. Horse-drawn plank levelers finally give a level muddy surface.

Transplanting the seedlings. Preparation of the fields is so timed that they are ready at the desired age of the seedlings. Similar to practices in other countries, the seedlings are pulled out of the bed by hand, tied in bundles, and hauled to the fields where they are distributed to the transplanters. Transplanting varies from five to 10 seedlings per hill, much more than the rate in other countries. The hills are not planted in straight rows, unlike in Japan, Indonesia, and India. Because the tall 50- to 60-day-old seedlings are not trimmed when transplanted, they will break and dry up if the fields are not submerged before or at transplanting.

Use and management of irrigation. Prepared seedbeds are submerged more or less continuously from seeding time until a few days after the seedlings are pulled. This is not quite so in other countries, where seedlings are generally given intermittent submergence while still in the seedbed.

Water management in the rice fields begins before transplanting and ends 10 to 14 days before harvesting. The soil surface is usually submerged 10 centimeters from transplanting until the first and last drainage which usually takes place 30 days after transplanting. This drainage which usually lasts for 14 days has been found necessary for drying the soil algae and scum in the fields. At this period, weeding and second application of fertilizer are generally done.

The depth of flooding the fields often varies with the temperature of the irrigation water. However, based on the experience of the farmers, 10 centimeters of submergence with water flowing slowly through the fields, is considered the best. Unfortunately, there has been no studies on the irrigation of rice in Spain; hence, the irrigation practices are based on the experience of successful rice farmers.

Irrigation water supply is considered very adequate and dependable in the rice-producing provinces. The Jucar River and Albufera Lake in Valencia, Ebro River in Tarragona, and Guadalquivir River in Sevilla are good sources of water. Parts of the flow of the Jucar and Ebro Rivers are diverted by diversion works, and conveyed by a system of canals into the fields. Water flows progressively from the higher to the lower fields and finally into the drainage canals.

Where the irrigation canals are lower than the fields, water is lifted by means of pumps and wheels that are mechanically operated. Such water-lifting devices are easily noticeable as one drives along the highway between the cities of Valencia and Sueca. The absence of service roads from the main highway into the interior fields is more than compensated by the presence of irrigation canals which are wide and deep enough to permit the use of sailboats. Thus, supplies are brought easily into the interior, and harvests are taken out for storage and milling in the city.

Weeding. Fields are weeded thoroughly twice; the first weeding is done sometime during drainage, and the second, three to four weeks after the first.

Fertilization. In Spain, rice growers fertilize their rice plantings with great amounts of nitrogen and phosphorus. Unlike the farmers in Italy, the Spanish rice farmers rarely use organic fertilizers. They usually mix their mineral fertilizers. The rate of application is 618 kilograms of sulphate of ammonia, 20 per cent N, per hectare, and 450 kilograms of superphosphate of calcium per hectare. The superphosphate may be applied before plowing, or if mixed with ammonia, before planting. The ammonium sulphate is usually applied twice, three-fourths of the amount before transplanting and the remaining one-fourth when the field is drained, generally 30 days after transplanting.

Harvesting, Threshing, and Drying

The crop is harvested by hand with sickle. The stalks are cut close to the ground, bundled, and left in the field for three to five days before they are brought to the threshing and storage site. Very often, the site is communal property of the farmers, and therein are the thresher, drying floor, and storage buildings. In some instances the mechanical thresher is pulled to the fields by a tractor, and the grain is brought to the drying site.

Sun drying is still very common in Spain. The rough rice is spread on concrete floors for sun drying. A day's drying during sunny weather is often sufficient. Mechanical drying is used mostly on bigger rice farms.

Storage and Milling

After rough rice is dried, it is weighed and stored in storage buildings until it is sold. The grain is weighed at the time of sale,

sacked and hauled to the mill, where it is stored until milled. In Valencia, most of the milling is done by the National Rice Cooperative of Valencia. But many small farmers mill their rough rice in their local cooperative mill, and after milling they may either take home and store their rice in their private granaries or leave them in their mill to be sold later by their cooperative association.

Cost of Producing Rice

From the Philippine Embassy in Madrid some cost data of rice production in Spain were obtained.[4] Some of the prices used are approximate, and they vary according to fluctuating conditions, yield and living conditions in the rice-producing areas. The cost of production per hectare varies from 3,900 to 4,500 pesetas (₱195 to ₱225). Based on these figures, and taking the average yield of 6,000 to 7,000 kilos, 136 to 160 cavans of palay per hectare, rice growers in Spain still make good profits and help supply the requirements of rice-deficient countries.

Why Spain Has High Yield of Rice

The high yield of rice in Spain is due to the following factors: (1) the varieties planted are high yielding and respond very well to heavy fertilization; (2) ideal climatic conditions for rice culture and some of the fields are virgin lands; (3) use of effective cultural methods in land preparation, fertilization, weed and disease control; (4) adequate irrigation water and effective management; (5) intensive culture especially in smaller holdings; (6) crop rotation on a moderate scale.

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[4] Dr. Francisco O. Santos of the College of Agriculture, University of the Philippines, was able to get some of these data during his trip through Spain.

NITROGEN CONSUMPTION: AN INDEX OF AGRICULTURAL DEVELOPMENT IN ASIAN COUNTRIES [1]

HORST VON OPPENFELD [2]

Every agriculturist, regardless of his line of specialization, hopes that his work will contribute towards agricultural development. He seeks to find ways and means by which farmers can increase their productivity, *i.e.*, their output per unit of input in land, labor, and capital. In a broader sense, productivity has been defined as "the ratio of production of wealth (goods, services, and human satisfaction) to human effort expandable." [3]

Differences in agricultural productivity are, of course, conditioned by quality and availability of agricultural resources. But even more important is the extent to which technology is being used for the development of these resources.

In a broad classification of agricultural development, most Asian countries are generally called "the less well-developed countries." This distinction is not very meaningful. The observant student soon learns that Asian countries differ widely in the application of agricultural technology. He looks for objective criteria or measures of agricultural development. Trying to relate development to certain factors and conditions, he finds this task most difficult. Many of the factors, such as education and mass acceptance of new methods, are intangible in nature. They are difficult to measure. So he turns to more tangible criteria. One measure for the application of technology is the rate at which commercial fertilizer, particularly nitrogen, is being used in various countries. The table in this paper shows figures for nine Asian countries.

The differences in the level of nitrogen application are most revealing. The four countries at the bottom of this array used only negligible quantities. Japan, on the other hand, may have pushed the use of nitrogen close to the point of diminishing physical returns. We ask ourselves what might explain these extreme differences. Is

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[1] General Contribution No. 889.

[2] Cornell Visiting Professor of Agricultural Economics.

[3] D. G. Gayer, C. L. Harriss and M. H. Spencer, *Basic Economics*, New York, Prentice-Hall, Inc., 1951, p. 23.

COUNTRY	NITROGEN CONSUMPTION kg. N/ha.[a]
Japan	109.6
Taiwan	86.7
Republic of Korea	54.1
Ceylon	18.4
Philippines	5.0
People's Republic of China	2.3
Indonesia	2.0
India	1.0
Pakistan	0.3

[a] Source: Dr. Ursula Ewald, *Recent Development of the World Fertilizer Market*—A statistical analysis—Institut fur Weltwirtschaft an der Universitat Kiel, 1957.

it the geographical location, the distance from the equator? Japan and Korea, topping the list, are at a greater distance from the equator. But why is China so low on this list? Is it the ratio of volcanic to tropical soil? This might explain why India with her vast expanse of tropical soil is so low on the list. But the Philippines and Indonesia have productive volcanic soils. Is it the knowledge of technical agriculture in colleges and universities? An attempt to correlate the standards and achievements of scientists in these countries with the rate of nitrogen application would be most frustrating, because one finds outstanding scientists in all these countries.

Not everybody may accept the rate of nitrogen consumption as an index of agricultural development. Yet it is safe to predict that all these countries will continue to move up on the ladder of nitrogen-use rates. Countries now at the bottom rungs will move up faster and will narrow the tremendous gap. This tendency is expressed in targets of national programs and five-year plans. Population pressure will accelerate the trend, through more intensive use of the productive land. Inevitably, this will entail greater use of chemical fertilizer.

Present consumption rates of nitrogen go a long way towards explaining country-to-country differences in agricultural development. But this does not mean that one must merely raise nitrogen application to the level of Korea or Japan and expect corresponding yield increments. Nor will such high application rates be profitable in all Asian countries. Other phases of scientific farming must be advanced to justify high rates of nitrogen application. Take the rice industry as an example. Some of the necessary conditions are:

1. Thorough land preparation with better plowing or subsoiling for better root development;
2. Breeding of stiff straw rice varieties which can absorb more nitrogen without lodging;
3. Acceptance of early maturing rice varieties to facilitate better land use through double cropping;
4. Timely cultivation and weeding enhanced through mechanical cultivation and/or chemical weed control;
5. Effective protection from insects, diseases and rodents through wider knowledge of these techniques;
6. Improvement of methods used in planting, harvesting, threshing, drying, storing and marketing;
7. Education that enables farmers to think and plan and to apply many phases of scientific techniques.

High rates of fertilizer application require considerable cash outlay and introduce a great risk factor. Crop failure means not only meager subsistence but loss of cash. Improved techniques as listed above provide a reasonable, though not complete insurance against crop failure. Farmers need sufficient operating capital to shoulder these expenses; their country must either provide capital for the establishment of fertilizer industries or it must have ample sources of foreign exchange to pay for imports of fertilizer.

The foregoing array of Asian countries by fertilizer use is a good measuring stick of agricultural technology. One can hardly find a better single indicator of agricultural development. A rise on the nitrogen-use scale can safely be predicted for all countries, particularly for those now on the lower rungs. Dr. Ewald prefaces her statistical analysis of the world fertilizer situation as follows:

> "In this first century of world commercial fertilizer industry there has never been a period as full of activity as the last 15 years. Consumption and production of mineral plant nutrients rose to an extent hitherto unknown, and world trade, too, reached an unprecedented level."

It is interesting to speculate about the development in fertilizer production and consumption in the Philippines during the next 15 years. Filipino farmers are just now beginning to accept scientific methods. Their inherent resistance to change is gradually breaking down. The use of fertilizer and other agricultural chemicals is bound to multiply. Once the wheel of progress moves, it is likely to gain more momentum.

THE MINERALIZATION OF THE ORGANIC MATTER OF SOME PHILIPPINE SOILS UNDER SUBMERGED CONDITIONS [1]

AMELIA B. LOPEZ and N. L. GALVEZ [2]

Soils from ten fields in four Luzon provinces were incubated for two weeks to determine the amount of mineralizable nitrogen under submerged conditions.

Irrespective of the nature of the soil organic matter and the microflora, the amount of mineralized nitrogen from ten different soil samples submerged in water was significantly and positively correlated with their contents of organic matter, total nitrogen, and the nitrogen uptake by rice plants. On the other hand, it was significantly and negatively correlated with the C/N ratio. Grain yields in greenhouse culture were significantly correlated with mineralized nitrogen, but not those in field cultures. The greater mud depth in the field was suggested as a possible cause of the difference.

The available nitrogen mineralized through decay of soil organic matter has long been recognized to be closely associated with the productivity of upland soils. Soils characterized by high humus mineralization rates are usually not only good physical media for plant growth but can also be made highly productive by application of inorganic mineral fertilizers.

Soil physical properties particularly aggregate stability and water and air permeability can be improved in upland soils by organic matter additions. These properties are not very important in submerged farming, because in lowland rice farming the soil is thoroughly puddled prior to planting. Under these circumstances organic matter probably exerts little influence on the physical properties of soils and its effects may therefore be considered as primarily nutritional.

This study was undertaken to determine the ability of ten Philippine soils to release nitrogen in available form under submerged condition. Their relative capacities in this respect were measured by the amount of available nitrogen produced in incubated submerged

[1] Central Experiment Station Contribution No. 1993. Portion of thesis submitted by the senior author to the Graduate School, U.P., 1957, for the M.S. degree.

[2] The suggestions of Drs. Lyle E. Nelson and E. H. Tyner, former and present visiting Cornell professors, respectively, in the Department of Soils, are gratefully acknowledged.

soils in the laboratory and by the yield and uptake of nitrogen by rice plants grown in the greenhouse.

The work was conducted in the laboratory and greenhouse of the Department of Soils, U.P. College of Agriculture, from April, 1956, to June, 1957.

REVIEW OF LITERATURE

Numerous workers have established that the chemistry of nitrogen availability in submerged soils is markedly different from that in well-drained soils.

Bartholomew (1929), Islam and Islam (1954), Jansen and Motzger (1928), Motzger (1928), Panganiban (1923), and Ponnamperuma (1955) reported that the transformation of organic nitrogen in submerged soils usually stopped at the ammonium stage and that the presence of nitrate nitrogen was practically nil. Sadasivan and Sreenivasan (1939) found that organic nitrogen brought into solution during organic matter decomposition as well as the decrease in total nitrogen in soils was greater under swamp conditions than in well-drained soils. Bhuiyan (1949) reported that the amount of NH_4-N in cropped soils increased rapidly after water-logging. The NH_4-N then decreased and remained constant after two months of water-logging until harvest when it disappeared and nitrates began to accumulate.

Panganiban (1923) did not find NH_3 in flooded rice soils. He assumed that this was due to a rather slow rate of decomposition of organic matter and rapid absorption by rice. Subrahmanyan (1927) showed that water-logging results in (a) a distinct increase in free NH_3 content; (b) an increase in alkalinity which is closely correlated with a corresponding increase in NH_4-N; (c) no appreciable CO_2 production or release of any soluble reducing matter capable of absorbing dissolved oxygen, and (d) a significant though slight decrease in bacterial numbers. Ponnamperuma (1955) stated that on submergence the fungi which affect ammonification in aerobic soils are replaced by the sluggish anaerobic bacteria, retarding both ammonification and immobilization of nitrogen.

MATERIALS AND METHODS

The ten soil samples studied consisted of the upper six inches of paddy soils from rice fields in four provinces. The pH values ranged from 5.25 to 6.75 which were within the optimum reaction

range for lowland rice. The fields from which the samples were collected had yields higher than average yields of paddy soils except field 407 in Calauan, Laguna (table 1). Its low yield of 36.4 cavans per hectare was caused by the early lodging of the palay. Among the samples Truog available phosphorus varied from 1.0 to 98.9 ppm, and potassium from 49 to 296 ppm. Fertilizer trials on these soils failed to show significant effects on the yield of grains.

Mineralization Test

For incubation studies and chemical analyses, subsamples which had passed through a 2-mm. mesh sieve were used.

The method used in the determination of mineralizable nitrogen was based on preliminary findings that maximum mineralization was attained two weeks after incubation. It was also found that the amount of mineralized nitrogen was fairly uniform at temperature ranging from 30 to 45°C.

Ten-gram samples of air-dry soil were submerged in water up to 2.54 cms. above the surface in test tubes and then incubated for two weeks at 35°C. After incubation, the supernatant liquid was decanted and the soil transferred to a Buchner funnel and leached with 200 ml. of N. KCl solution. The leachate was made up to 250 ml. volume with distilled water. One hundred ml. aliquots were used for the determination of NH_4-N by the micro Kjeldahl distillation method and five ml., for the determination of NO_3-N by the brucine method. Total mineralized N was obtained by summation and reported as m.e. NH_3 per 100 grams soil (table 2, column 2).

Greenhouse Test

Bulk soil samples which had passed through a 0.635-cm. mesh sieve were used in the greenhouse test.

Earthen pots with inside surfaces painted with Sillers asphaltum paints were used as the culture containers. The pots in the first culture were 30 cm. in diameter and 34 cm. high with a capacity of 15 kgm. soils. However, in the second culture smaller pots (20 cm. in diameter and 24 cm. high) with a capacity of five kgm. soils were used because of lack of soil.

In the first culture, 15 kgm. of soil in each of the 40 earthen pots were thoroughly puddled and allowed to stand for three days. Each pot had three hills and in each hill two Milfor 6(2) dapog-

TABLE 1.—*Description of the soils* [a]

SOIL NO. & LOCATION	SOIL TYPE	PARENT MATERIAL	FIELD YIELD [b] IN CAV./HA.	pH	AVAIL. P IN PPM	AVAIL. K IN PPM
1. Lamao Expt. Sta., Lamao, Bataan	Pilar sandy loam	basaltic alluvial	78.6 (RF–33)	5.68	1.0	105
2. Field 77, Calauan, Laguna	Calumpang clay loam	alluvial (tuffaceous)	64.4 (RF–4)	6.13	59.8	217
3. Hanggan, Bay, Laguna	Calumpang clay	alluvial from basic volcanic materials	86.8 (RF–5)	6.75	51.8	296
4. Central Expt. Sta., College, Laguna	Calumpang clay loam	basic volcanic materials	57.2 (RF–24)	5.65	2.9	126
5. Talon, Las Piñas, Rizal	Guadalupe clay	alluvial (tuffaceous)	78.9 (RF–19)	5.25	2.7	155
6. Gatid, Sta. Cruz, Laguna	Lipa loam	volcanic tuff	65.9 (RF–23)	6.43	98.9	140
7. Maligaya Rice Expt. Sta., Muñoz, Nueva Ecija	Maligaya clay loam	alluvial (basaltic)	57.5 (RF–39)	6.40	14.9	49
8. Sta. Rosa, Pilar, Bataan	Pilar silt loam	alluvial (basaltic)	79.5 (RF–32)	5.85	52.4	117
9. Field 407, Calauan, Laguna	Calumpang clay	alluvium from basic volcanic materials	36.4 (RF–25)	5.83	58.2	155
10. Pamplona, Las Piñas, Rizal	Guadalupe clay	tuffaceous materials	54.4 (RF–20)	5.33	10.5	123

[a] Descriptions supplied by Messrs. Marcelino C. Lopez and Martin E. Raymundo of the Department of Soils.
[b] Figures represent yield of field experiments in cavans per hectare of the same soils used in the greenhouse studies. Figures in parenthesis indicate number of field fertilizer experiments.

TABLE 2.—*Amount of mineralized nitrogen of submerged soils after 14 days of incubation, soil properties, greenhouse yields and nitrogen uptake*

SOIL NO. & LOCATION	MINERALIZED N IN M.F. NH_3/100 gm.	PER CENT O.M.	PER CENT TOTAL N	C/N RATIO	FIELD YIELD IN CAV./HA.	GRAIN YIELD (gm./pt) 1st	GRAIN YIELD (gm./pt) 2nd	PLANTINGS TOTAL DRY MATTER (gm./pot)		PLANTINGS TOTAL NITROGEN UPTAKE (gm./pot)	
1. Lamao	0.637	2.14	0.104	11.9	78.6	49.6	16.4	100.9	42.0	0.573	0.286
2. Calauan Field 77	1.239	3.80	0.184	12.0	64.4	50.3	19.4	137.5	51.5	0.854	0.533
3. Bay	1.653	5.28	0.242	12.6	86.8	69.8	49.1	177.4	118.4	1.014	1.094
4. College	1.106	3.82	0.152	14.6	57.2	32.5	15.5	87.3	56.5	0.412	0.391
5. Talon	0.477	2.78	0.104	15.5	78.9	19.2	13.4	49.4	36.9	0.326	0.250
6. Gatid	0.512	4.10	0.154	15.5	65.9	31.1	10.9	81.9	35.1	0.449	0.391
7. Maligaya	0.142	2.22	0.074	17.4	57.5	10.6	5.5	26.8	16.4	0.156	0.110
8. Pilar	0.251	2.33	0.092	14.7	79.5	26.5	8.9	61.8	31.8	0.394	0.271
9. Calauan Field 407	1.186	4.98	0.243	11.9	36.4	55.2	10.1	138.5	36.0	0.763	0.251
10. Pamplona	0.255	2.20	0.084	15.2	54.4	12.2	8.2	30.3	22.3	0.177	0.154
L.S.D. (.01) = 0.107											
Correlation Coefficient		0.856[a]	0.912[a]	−0.732 [b]	0.036 N.S.	0.883[a]	0.771[a]	0.936[a]	0.831[a]	0.917[a]	0.800[a]

[a] Highly significant.

[b] Significant.

grown seedlings were planted on August 7, 1956. Four replications arranged in a randomized complete block design were made. After the seedlings had established themselves, they were kept constantly submereged with distilled water additions up to a level of five cm. above the soil surface until one week before harvest on December 3, 1956.

In the second culture, five kgm. of soil similarly prepared in smaller pots and capable of accommodating only one hill was planted with two seedlings and cared for as previously described.

To follow the course of mineralization in submerged soils, soil samples were taken one week, two weeks, and thereafter every third week following transplanting for the determination of exchangeable NH_4. Samples of flood water were taken every two weeks and then every third week after transplanting for soluble nitrogen determination ($NH_4 + NO_3$) until maturity. The data are given in table 3.

Harvesting was done on December 3, 1956, one week after the soil had been completely drained of water. The stalks were cut close to the soil surface. The grain and the straw were dried separately in a forced draft oven at 70-75°C, weighed, ground in a Wiley mill and analyzed for total N by the semi-micro Kjeldahl method. Total nitrogen uptake obtained by summation is given in table 2, column 12.

RESULTS AND DISCUSSION

Mineralization studies on the ten soils incubated at 35°C for two weeks showed that the amount of nitrogen mineralized after two weeks varied (table 2, column 2). The amount ranged from 0.142 to 1.653 m.e. NH_3 per 100 grams soil. This explains partly why the field response of the paddy soils to nitrogen fertilization was not consistent. The highest value is shown by soils from Bay and the lowest, by soils from Maligaya.

A correlation study of the amount of mineralized nitrogen (column 2) and organic matter (column 3) shows that a highly positive significant correlation coefficient exists between them (table 2). This is highly suggestive that the amount of organic matter might be employed as an index of nitrogen availability in lowland rice soils, irrespective of the nature and kind of microflora in the soil.

Ensminger and Pearson (1950) and Allison and Sterling (1954) observed total soil nitrogen as an important factor in determining the amount of available nitrogen that well-drained soils will supply.

Column 4 shows a close positive relationship with the amount of mineralized nitrogen. From this it may be inferred that the total soil nitrogen may also be an index to the nitrogen-supplying ability of lowland soils.

From these results, the soil organic matter or total nitrogen content of soils would appear to be good indices of the potential supply of available nitrogen of lowland rice fields. High values of either one may indicate that adequate amounts of available nitrogen will be released.

The C/N ratio of soil organic matter (table 2, column 5), which Hutchings and Martin (1934) reported to be highly correlated with the rate of organic matter decomposition in well-drained soils is negatively correlated with the amount of mineralized nitrogen. This indicates that under lowland soil conditions, the C/N ratio is also indicative of the mineralization rate, the rate becoming rapid with narrowing C/N ratio and vice-versa.

The Maligaya soils with widest C/N ratio (17) show the least amount of mineralized nitrogen, 0.142 m.e. NH_3-N per 100 grams soils. Talon, Gatid, Pamplona, Pilar and College soils with C/N ratios of 15.5, 15.5, 15.2, 14.7 and 14.6, respectively, show amounts ranging from 0.251 to 1.106 m.e. NH_3N per 100 grams soils. On the other hand, Lamao, Calauan, fields (77 and 407) and Bay, each with a C/N ratio of 12 indicate amounts of nitrogen mineralized ranging from 0.637 to 1.653 m.e. NH_3-N per 100 grams soils.

GREENHOUSE TEST

Yield and total dry matter production

Total dry matter, grain yield and nitrogen uptake show highly positive significant correlation with the amount of mineralized nitrogen (table 2). This corroborates a fact which has been recognized in well-drained soils, that the growth and development of crops is closely associated with the amount of available nitrogen in the soil.

While the amount of mineralized nitrogen was closely associated with greenhouse yields, there was no correlation with field yields. This may be attributed mainly to the fact that under field conditions the depth of the mud can vary unlike that in the pots where the volume and depth of the soils was uniform. In the first greenhouse test, the mud depth in each of the ten soils was 30 centimeters in the bigger pots and 15 centimeters in the smaller pots. On the other hand,

the mud depth in the fields from which the soils were secured varied from 30 to 150 centimeters, every centimeter of which is a potential source of available nitrogen.

It is evident in table 2, columns 9 and 10 that yields were markedly influenced by the depth of the root zone. The deeper the root zone, the greater were the yields. The larger pots which contained 15 kilograms of soils have penetrable mud depth of about 26 centimeters whereas the smaller pots, which contained only five kilograms of soil, only about 11 centimeters. The effect of mud depth on yield has also been observed in the lysimeter studies of the Department. The large tanks with a mud depth of about 43 centimeters show yields more than three times that of the smaller tanks with mud depths of about 18 centimeters.

The highly significant correlation between results of greenhouse experiments and incubation studies on organic matter mineralization where mud depth was constant indicates the possibility of using the incubation method as a means of determining the nitrogen-supplying capacity of submerged soils. Failure to obtain a correlation between the amount of mineralized nitrogen under laboratory condition and field yields suggests that further experiments need to be made where the mud depth of the field soils is considered.

Course of Mineralization

Data on the course of the decomposition of soil organic matter may explain why rice exhibits sporadic yellowing and greening under greenhouse and field conditions. This phenomenon is not uncommon but plant physiologists and soil fertility researchers have not been able to explain it. Since nitrogen may be the cause of this, data on the amount of mineralized nitrogen at the different ages of rice plants may shed some light on this unexplained behavior of lowland rice.

Table 3 shows the amount of exchangeable and soluble nitrogen present in submerged soils when the rice plants were 7, 14, 35, 56, 77 and 105 days old.

It is evident that at no time during the growth of rice plants in any of the ten soils did the amount of exchangeable soil nitrogen bear any constant ratio with that of soluble nitrogen.

It also appears that there is always a continuous supply of available nitrogen during the vegetative growth of rice although the

TABLE 3.—*Amount of available nitrogen in the soil at different ages of rice plants (m.e. NH_3 per 100 grams soil)*

SOIL NO.	7 DAYS		14 DAYS		35 DAYS		56 DAYS		77 DAYS		105 DAYS		MEAN	
	Exch.[a]	Sol.[b]	Exch.	Sol.	Exch.	Sol.	Exch.	Sol.	Exch.	Sol.	Exch.	Sol.	Exch.	Sol.
1	.315	—	.127	.910	.098	1.205	.202	.273	.074	.233	.156	.169	.162	.558
2	.182	—	.169	1.228	.083	1.137	.201	.284	.055	.259	.179	.104	.145	.602
3	.198	—	.202	.125	.133	.159	.199	.102	.037	.178	.167	.246	.156	.162
4	.141	—	.161	.455	.099	.375	.248	.170	.019	.168	.165	.182	.139	.269
5	.120	—	.049	.147	.062	.102	.264	.114	.0003	.165	.162	.182	.1095	.142
6	.128	—	.162	.865	.063	.592	.176	.194	.036	.233	.169	.117	.122	.400
7	.143	—	.047	.191	.173	.159	.114	.136	0	.165	.074	.130	.092	.159
8	.029	—	.059	.170	.126	.262	.213	.191	.030	.165	.200	.142	.110	.126
9	.282	—	.138	.785	.123	.933	.237	.262	.039	.181	.137	.143	.159	.461
10	.128	—	.069	.091	.080	.114	.164	.159	.175	.156	.127	.091	.124	.122
Mean	.167	—	.118	.497	.104	.504	.202	.189	.0465	.190	.154	.152	.132	.306

[a] Exch. = Exchangeable.

[b] Sol. = Soluble.

amount consistently changes. This may account for the sporadic yellowing and greening stands of rice plants during their vegetative periods.

It is further evident in the table that the amount of available nitrogen is comparatively higher at the early stage of incubation than at the latter stages. This indicates that puddling soils under submerged condition is conducive to the rapid decomposition of organic matter.

This also suggests that the decomposition of rice straw in lowland rice fields with high mineralization rates could be hastened by plowing under the straw and thoroughly puddling the soil. In so doing, the early application of nitrogenous fertilizer might be dispensed with. Cultivating to control weeds and stirring of the soil if done occasionally may dispense with the need of the second application of nitrogenous fertilizers.

If the mineralizing capacity of paddy soils is low, both the early and late application of nitrogen is recommended. This applies especially to soils which have shallow mud and can not be submerged at will because of lack of irrigation water.

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Because of its international character, scientific aid is given and is received freely and without thought of patronizing or being patronized; scientific aid is acceptable without question, and the giving of it is an accepted responsibility. Men have been united by science since the time of the Renaissance, and political internationalism can learn much from the scientific pattern.

—*William Vogt*

FOUR DISEASES OF COFFEE HITHERTO UNDESCRIBED IN THE PHILIPPINES [1]

F. T. Orillo and R. B. Valdez

WITH EIGHT TEXT FIGURES

Four fungous diseases of coffee, apparently new in the Philippines, have been observed in the coffee plantings of the College of Agriculture, Bureau of Plant Industry, and some private growers from July, 1956, to November, 1958. These diseases occur sporadically and are at present only of minor economic importance. However, they have been observed to cause considerable damage to individual coffee trees involved, under conditions favorable for disease development. These maladies are described below to enable coffee growers to recognize and possibly eradicate them before they become well established in the plantations. Specimens of the diseases are preserved in the herbarium collection of the Department of Plant Pathology.

1. *Twig Girdle and Berry Rot*

This disease was first observed during the later part of July, 1956, on two-year-old Arabica trees in the coffee collection and disease orchard of the Department of Plant Pathology. It was also observed on Arabica trees in the Bureau of Plant Industry Stations in Tiaong, Quezon, and at Baguio City; on Robusta trees in Amadeo, Cavite, and also on Excelsa trees in the old coffee plantation of the College and in the plantation of the Matutum Agricultural Development Corporation in Mindanao.

Symptoms. On the stem, the disease first appears as minute cracks, usually starting on the vertical branch just above the brown wood, followed by water-soaking of the bark. During moist weather, abundant mycelial growths ramify on the infected as well as on the seemingly healthy areas. The hyphae anastomose and form abundant white to pinkish bodies that resemble minute sclerotia. The infected bark finally peels off but the affected branch continues to live until the girdled portion is completely dried (fig. 1). Death of

[1] Central Experiment Station Contribution No. 1994.

the top main stem results in the formation of abundant verticals, which when left unpruned favor rapid development of the disease. In less serious or incipient infections the affected portion recovers, but the new bark growths are distorted and still have the causal organism on them. This is believed to be the means by which the fungus tides over adverse conditions and carries over the disease from season to season.

Fig. 1.—*Coffea arabica* stem showing symptoms of "twig girdle" disease. (*Photograph taken by the Photographic Division*).

The stem infections may enlarge and spread to the berries where they produce sunken, water-soaked lesions. Infected immature berries shrivel and die and are covered by a dirty white to pinkish floury

mold (fig. 2). The beans of infected mature berries are slightly affected. The disease is favored by short periods of sunshine and intermittent showers.

Fig. 2.—*C. arabica* berries infected with the "twig girdle" fungus. (*Photograph taken by B. V. Travis and printed by the Photographic Division*).

The disèase has been reproduced by repeated inoculations with pure culture and infected plant parts. When infected twigs or berries are used as inoculum, infection occurs two weeks after inoculation, but when pure cultures are used, symptoms appear within two to three weeks.

Etiology. Spores of the causal fungus have not yet been observed on the host nor on artificial culture media. Efforts to induce sporulation have so far been unsuccessful, hence this fungus has not yet been identified. Further studies on the disease and on the physiological and morphological characteristics of the organism are in progress.

2. *Zonal Leaf Spot*

This disease was first observed during the later part of December, 1956, on a few Arabica trees in the College orchard. In April, 1957, the same type of infection was seen on Robusta coffee in Amadeo, Cavite. A very similar disease has been reported by Fawcett [2] (1915) in Porto Rico and by Abbott [3] (1929) in Peru. Both investigators reported the causal fungus as *Cephalosporium* sp.

Symptoms. The disease attacks mainly the leaves and produces circular to irregular lesions. The lesions start as minute, depressed specks on any portion of the leaf and gradually enlarge with age. A peculiar characteristic pattern of growth of the lesion is the formation of gray and brown rings. Such rings when viewed on the upper surface of the leaf are sometimes incomplete. When conditions are favorable for disease development, the lesions enlarge rapidly with the characteristic "zoned" pattern. During the summer months, infection is very slow; lesions are very irregular and do not show the "zoned" pattern (fig. 3).

On the undersurface of older lesions, a white, compact, mycelial mat appears during favorable conditions. Abundant spores of the fungus are borne on the mycelial mat. Microscopic examinations showed that the causal fungus belongs to a species of the genus *Cephalosporium.*

Symptoms very similar to those found on coffee have been observed on *Piper loheri* C. DC., *Calopogonium muconoides* Desv., *Urena lobata* Linn., and *Anamirta cocculus* Merr. These plants were growing close to the infected coffee trees.

Repeated inoculations with pure culture of the organism resulted in the production of the disease 12 days after inoculation. Physiological and morphological studies of the fungus are in progress.

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[2] G. L. Fawcett, *Porto Rico Exper. Sta. Bull.* No. 17 (1915).
[3] E. V. Abbot, *Phytopathology* **19** (7): 645-656 (1929).

Fig. 3.—*C. arabica* leaves showing: A, B. Symptoms of "zonal" leaf spot produced in the field by natural infection. C. Symptoms produced by artificial inoculation with pure culture of the fungus. D. Healthy leaf. (*Photograph taken by the Photographic Division*).

3. *Rhizoctonia Blight*

This disease was first observed on pigeon peas (*Cajanus cajan* [L.] Merr.) which were used as temporary shade for coffee transplants during the later part of August, 1956. It caused complete blighting and death of all infected Cajanus plants. Abundant, big, light brown sclerotial bodies were observed on the blighted leaves. Some coffee transplants were also infected and sclerotial bodies formed on the lesions. Very similar symptoms were also observed

on 12-month-old coffee seedlings in the nurseries of the College and the Canlubang Sugar Estate, respectively.

Potted coffee seedlings inoculated with either pure cultures of the fungus or infected twigs and leaves of pigeon pea showed symptoms of the disease in two to three days under moist chamber conditions. On potato-dextrose agar, the fungus forms sclerotial bodies that resemble very closely those formed by the coffee-seedling damping-off isolate.

During the later part of August, 1958, a severe form of blighting that caused about 30 to 50 per cent defoliation was observed on three- and four-year-old Arabica trees. The causal fungus attacked the leaves, berries, and tender shoots and finally produced severe die-back. Infection on Robusta and Excelsa trees was slight. The disease is favored by intermittent warm and rainy weather. Sclerotial bodies are neither formed on infected plant parts nor on PDA (potato-dextrose agar) cultures.

Narasimhan [4] (1934) and Venkatarayan [5] (1946-1947) described a very similar disease which they referred to as "black rot" or "koleroga" in Mysore. They identified the causal fungus as *Corticium koleroga* (Cke.) Von Hohnel. Narasimhan's description of the symptoms accompanied by photographs illustrating the early pellicle and the late sclerotial stages clearly distinguishes it from the thread blight disease caused by *Pellicularia koleroga* Cke.

Symptoms. Infection on the leaves is characterized by water-soaked blotches which are usually irregular in shape. The blotches may occur on any portion of the leaf blade (fig. 4). Young and mature leaves are equally subject to infection. Under favorable weather conditions, the mycelium ramifies so rapidly that in less than a week the infected leaves may be totally blighted. The blighted leaves easily drop to the ground. During dry spells the affected portions of the leaves appear to be sun-scorched.

The undersurface of the blighted areas is covered by a thin yellowish-brown mycelial mat which is discernible only when the leaves are dry. Occasionally, a mat composed of whitish, fine, short-celled hyphae may also cover the underside of thick overlapping leaves. Lesions produced by this type of mycelial growth are small and uniformly distributed throughout the whole leaf area.

[4] M. J. Narasimhan, *Phytopathology* **23**, 875-886 (1934).
[5] S. V. Venkatarayan, *The Mysore Agric. Jour.*, **25**, 320 (1946-1947).

Fig. 4.—*C. arabica* leaves showing Rhizoctonia blight infection. (*Photograph taken by the Photographic Division*).

Usually, mycelial strands accumulate on the axils so that when the dead leaves become detached from the stem, they may be kept hanging by means of said strands (fig. 5).

Fig. 5.—A portion of *C. arabica* tree infected with Rhizoctonia blight. (*Photograph taken by the Photographic Division*).

Infection on the berries is manifested by water-soaked sunken lesions. Infected berries gradually shrivel and appear rotten and moldy with age (fig. 6).

Fig. 6.—A. *C. arabica* berries showing symptoms of Rhizoctonia disease. B. Healthy berries. (*Photograph taken by the Photographic Division*).

A disease with symptoms very similar to those described above has also been observed on *Gliricidia sepium* (Jack.) Steud, *Centrosema pubescens* Benth., *Piper loheri* C. DC., *Lantana camara* Linn., and a number of grass weeds. The disease was readily produced on cacao by artificial inoculation.

Etiology. The writers consider the disease to be caused by a species of *Rhizoctonia.* This fungus differs from that which causes the thread blight disease with respect to the following: (1) it does not produce the tree-like mycelial ramifications and concentric lesions on the infected leaves; (2) the mycelial strands it produces are weaker than those produced by the thread blight fungus.

4. *Thread Blight*

This disease is probably not new in the Philippines but its occurrence apparently has not yet been reported. It has been observed on Arabica, Robusta, and Excelsa trees in the College of Agriculture and in many places in the country where coffee is grown. It thrives

best in thickly shaded places and becomes severe during warm and rainy weather. It attacks the stems, leaves, and berries.

The same or a very similar disease has been reported in India, Costa Rica, Venezuela, Jamaica, New Caledonia, the Belgian Congo, Porto Rico, Guatemala, Colombia, Trinidad, Surinam, Cuba, Brazil, Malaya, Queensland and the Lesser Antilles, occurring on a wide variety of host plants.

Symptoms. The fungus forms coarse, white to brown mycelial strands which are tightly appressed usually on the under side or on shaded portions of branches occasionally causing necrotic lesions on tender shoots. These strands, upon reaching the petioles, form thick mycelial tufts which gradually advance to the leaf blade and produce white, tree-like ramifications on the nether surface. At the points of branching of these tree-like mycelial ramifications, circular to irregular concentric lesions are produced (fig. 7). These lesions start from the size of a pinhead and gradually enlarge to about six mm.

Fig. 7.—*C. arabica* leaves infected with the thread blight fungus. Note the tree-like ramifications of the mycelium on the surfaces of the leaves. (*Photograph taken by the Photographic Division*).

in diameter. It is not uncommon for two or more lesions to coalesce and form large spots. Severe infection on the leaves causes premature defoliation and death of small branches. Usually the dried infected leaves do not fall to the ground but are left hanging from the stem by means of the tough mycelial strands.

The berries may also be infected at any age. Circular, brown, sunken lesions occur on the points of branching of the mycelial strands. The lesions gradually enlarge to about 1½ cm. in diameter (fig. 8). In severe cases, the fungus invades the peduncle, girdling it and eventually causing premature drying of the berry. Infection on the berries may involve the beans and cause them to blacken.

Fig. 8.—*C. arabica* twigs, leaves, and berries infected with the thread blight fungus. (*Photograph taken by the Photographic Division*).

The disease has also been noted on *Piper loheri* C. DC., *Theobroma cacao* Linn., *Vanilla planifolia* Andrews, and *Gliricidia sepium* (Jack.) Steud. Among the host plants, *Gliricidia sepium*, a common shade tree for coffee, appears to be preferred by the fungus.

The disease was reproduced on potted coffee plants as well as on plantation coffee two weeks after inoculation with either pure culture of the fungus or infected plant parts. Spores of the causal organism have not yet been noted. Further studies on the disease are in progress.

Etiology. The disease is believed to be caused by *Pellicularia koleroga* Cke.

* * *

Agriculture needs the help of fundamental biology; without it, it will starve. Fundamental biology needs the support, the encouragement, the satisfying outlets, and the cooperative opportunities that agriculture can provide; without it, it may grow thin.

—*H. B. Tukey*

SOME ASPECTS OF POULTRY FARM MANAGEMENT AND MARKETING [1]

PEDRO R. SANDOVAL and ERNESTO P. ABARIENTOS

Poultry farm operators owned an average of 4.9 hectares of cropland in Nueva Ecija, 1.3 hectares in Pangasinan, and 4.5 hectares in Camarines Sur. The occupations of poultry raisers varied from farming to the different professions.

Housing space per bird in Camarines Sur ranged from 2.0 to 2.8 square feet as compared to 3.0 to 3.6 square feet in Nueva Ecija and Pangasinan. The combination of cogon-bamboo-bamboo as housing materials for roof, wall, and flooring, respectively, was common in Nueva Ecija and Pangasinan. The nipa-bamboo-bamboo combination prevailed in Camarines Sur. Laying houses were mostly without range in Nueva Ecija and Camarines Sur.

Chicks as starting stocks were common in the three provinces. Nueva Ecija and Pangasinan used mostly commercial pre-mixed feeds whereas in Camarines Sur poultry raisers mixed their own feeds. The average weekly production was 4 eggs in Nueva Ecija and Camarines Sur and 3.3 eggs in Pangasinan. The eggs were sold without being classified according to size or cleaned. Feed distributors were the most important market outlets for eggs in Nueva Ecija and Pangasinan, and retailers, in Camarines Sur. Meat production was not the major interest of poultry raisers. Cash payment was the common practice in selling eggs in Camarines Sur. In Nueva Ecija and Pangasinan, eggs were exchanged for feeds and sold for cash.

Philippine agriculture is chiefly crop farming, with the area of land averaging 2.4 hectares. With the typical farmer spending 5.3 months of work on his farm, 2.1 months in off-farm employment, and 4.6 months in virtual unemployment, poultry raising offers possibilities for helping solve rural underemployment.[2] Moreover, it is one of the livestock enterprises that could fit in many of the existing

[1] Central Experiment Station Contribution No. 1995. Part of Research Project No. 1248.

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[2] Horst and Judith von Oppenfeld, P. R. Sandoval, and J. C. Sta. Iglesia, "Farm Management, Land Use and Tenancy in the Philippines," Central Experiment Station Bulletin 1, August, 1957.

farm organizations. As a supplementary enterprise, it could help increase the incomes of Filipino farmers, without necessitating additional land for the enterprise.

Poultry farming could also very well use farm by-products such as rice bran, corn bran, copra meal, and secondary crops as mungo, soybeans and legumes. The latter are usually raised in rotation with rice and corn to improve soil fertility.

While poultry raising has gained popularity among farmers particularly in Central Luzon, no economic analysis of the poultry farm business has been made. However, substantial research on poultry feeds and feeding has been undertaken by both government and private agencies. Research on the economic aspects of poultry raising, with emphasis on the management and marketing practices of the poultry farmers, may provide valuable data for the formulation of recommendations regarding the improvement of the poultry farm business. The ultimate objective would be to increase the net returns to the farmers.

OBJECTIVE AND PROCEDURE

To undertake an economic analysis of the management and marketing practices of poultry farms, a two-phase study was undertaken in selected municipalities of Pangasinan, Nueva Ecija, and Camarines Sur. The first phase of the study was a survey which required a complete enumeration of poultry raisers in the selected municipalities. It included preliminary information which served as a basis for the second phase of the study. In the latter phase, the selected poultry farm operators maintained a detailed set of cost and return records which were checked monthly for a period of twelve months.

This paper deals with the first phase of the study. It is an analysis of the information collected from 86 poultry raisers in Binmaley and Pozorrubio, Pangasinan, in December, 1957; 100 in Papaya, Nueva Ecija, in January, 1958; and 70 in Naga City and Milaor, Camarines Sur, in April, 1958. Only poultry operators with over 50 layers were included in this study. Farms with 51 to 200 layers were classified as Small (S); 201 to 500 as Medium (M); and over 500 as Large (L).

GENERAL INFORMATION

Cropland information. The poultry farm operators either owned or rented cropland. Nueva Ecija operators had an average of 4.4

hectares of lowland rice field; Camarines Sur, 3.7 hectares and Pangasinan, 0.9 hectare (table 1). For Nueva Ecija and Pangasinan, there was an aggregate of less than 0.6 hectare devoted to corn, upland rice, sugar cane, and other crops. However, in Camarines Sur, 0.5 hectare was planted to upland rice and 0.3 to citrus and coconut farms. In terms of total area of cropland, Pangasinan had less than ⅓ (1.3 hectares) compared to Nueva Ecija.

TABLE 1.—*Average area of cropland, 256 poultry farm operators*

CROPLAND	NUEVA ECIJA [a]	PANGASINAN	CAMARINES SUR [b]
Number of farms	100	86	70
		hectare	
Lowland rice field	4.4	0.9	3.7
Upland rice field	0.1	0.1	0.5
Corn field	0.3	0.1	—
Sugar cane field	0.1	—	—
Fish pond	—	0.1	—
Tobacco-vegetable	—	0.1	—
Others	[c]	—	0.3 [d]
Total	4.9	1.3	4.5

[a] Four farms reported 32.5 hectares of wasteland and one farm, 9 hectares of pastureland.
[b] One farm reported 50 hectares of pastureland.
[c] Less than 0.1 hectare of betel farm.
[d] Citrus and coconut farms.

One operator in Camarines Sur reported owning a 50-hectare pasture. In Nueva Ecija, 4 farms reported 32.5 hectares of wasteland.

Livestock information. Aside from chickens, poultry operators kept other livestock such as swine, carabaos, cattle, goats, horses, ducks, geese and turkeys (table 2). Quantitatively, cattle ranked

TABLE 2.—*Average number of livestock kept* [a]

TYPE OF LIVESTOCK	NUEVA ECIJA	PANGASINAN	CAMARINES SUR
Number of farms	100	86	70
		number	
Hogs and pigs	3.6	2.9	2.7
Carabaos	1.8	0.7	1.1
Cattle	5.8	[c]	0.8
Goats	0.9	0.4	0.2
Horses	0.4	0.2	0.1
Other poultry [b]	0.5	0.1	15.8

[a] Chickens not included.
[b] Ducks, geese and turkeys.
[c] Less than 0.1 hectare.

first in Nueva Ecija, swine in Pangasinan, and other poultry in Camarines Sur. There was one poultry raiser in Nueva Ecija, however, who owned a cattle ranch. This accounted for the great number of cattle per farm in Nueva Ecija. In Camarines Sur only one farm reported having cattle. In the same province, the large proportion of other poultry were mallard ducks ("itik").

The poultry flock. For all farms, the individual flock consisted of layers, pullets, chicks, and roosters. Only the medium flocks of Nueva Ecija and the small and large flocks of Camarines Sur kept cockerels. The size of flocks in terms of layers ranged from 96 in Camarines Sur to 1,058 in Nueva Ecija (table 3a).

TABLE 3a.—*Poultry data by size of farm*

ITEM	NUEVA ECIJA			PANGASINAN			CAMARINES SUR		
	S	M	L	S	M	L	S	M	L
Number of farms	36	47	17	48	32	6	55	11	4
	average number per farm								
Chicks	74	68	100	32	37	167	45	105	250
Pullets	16	13	19	13	24	33	65	64	690
Cockerels	—	2	—	—	—	—	4	—	76
Layers	122	322	1058	120	276	833	96	250	980
Roosters	[a]	5	33	[a]	7	23	2	9	31
	per cent of total number of farms								
Chicks	22	21	12	12	16	18	31	45	25
Pullets	8	6	12	15	16	6	62	45	100
Cockerels	—	2	—	—	—	—	16	—	75
Layers	100	100	100	100	100	100	100	100	100
Roosters	19	36	76	27	56	29	27	56	100

[a] Less than one.

In terms of rooster-layer ratio, the number of roosters varied from one to every 30 layers to about one to every 125 layers. There was a tendency for the large farms in the three provinces and the medium farms in Camarines Sur to keep one rooster for every 30 layers. This indicates that they were apparently interested in producing hatching eggs. On the other extreme, the small farms of Nueva Ecija kept less than one rooster for every 122 layers which indicated their preference for specialization in the production of table eggs. In the latter farms, it was possible that the roosters were kept to produce breeding eggs as a source of chicks for future replacements and/or enlargement of the flocks.

Single-Combed White Leghorn was the most popular breed in the three provinces. It was the only breed kept in the survey farms of Camarines Sur and Nueva Ecija except in one farm in the latter

province which had both White Leghorn and New Hampshire layers. Pangasinan farms, however, kept other breeds which included New Hampshires, Barred Plymouth Rocks, and Rhode Island Reds (table 3b).

TABLE 3b.—*Breeds of chicken in Pangasinan* [a]

BREED	AVERAGE PER FARM			
	Layers	Pullets	Roosters	Chicks
			number	
Single-Combed White Leghorn	220	125	12	229
New Hampshire	53	—	8	50
Rhode Island Red	46	50	4	250
Barred Plymouth Rock	75	—	—	—
			number of farms	
Single-Combed White Leghorn	86	14	34	15
New Hampshire	12	—	5	1
Rhode Island Red	7	1	1	1
Barred Plymouth Rock	2	—	—	—

[a] Single-Combed White Leghorn was popular in both Camarines Sur and Nueva Ecija.

As an enterprise, poultry farming was relatively new in the three provinces. It is interesting to note that the small flocks predominated among those that had less than four years of experience in poultry farming (table 4).

TABLE 4.—*Years of experience in poultry farming*

PROVINCE AND SIZE OF FARMS	NUMBER OF FARMS	NUMBER OF YEARS			
		Below 4	4-7	Over 7	Total
			per cent		
Nueva Ecija:					
Small	26	42	35	25	100
Medium	47	36	30	34	100
Large	17	23	18	59	100
Pangasinan:					
Small	48	83	17	—	100
Medium	32	56	44	—	100
Large	6	17	83	—	100
Camarines Sur:					
Small	55	78	15	17	100
Medium	11	46	18	36	100
Large	4	50	50	—	100

None of the farms in Pangasinan had more than seven years of experience, although 83 per cent of the large farms were in this category. On the other hand, the large farms of Nueva Ecija appar-

ently pioneered in this type of enterprise since 59 per cent had experience in poultry farming for more than seven years.

The poultry farm operator. That poultry raising can be engaged in by individuals of varied occupations is indicated in table 5. Farmer-operators predominated in Pangasinan and in small and medium flocks in Nueva Ecija. It is interesting to note that majority of the landlord-operators in Pangasinan were owner-operators of rice farms which they leased to other farmers. This enabled them to devote all their time to poultry raising. About one out of every four poultry operators of the medium and large farms in Nueva Ecija and Camarines Sur were businessmen. In Nueva Ecija, 29 per cent of the large poultry operators were poultry feed dealers. This was true with a number of the medium-size flock operators in the three provinces which combined poultry raising with the business of feed distribution.

There were only relatively few poultry operators who had no other occupation. Many of the operators of the medium and large poultry farms utilized hired labor.

TABLE 5.—*Other occupations of poultry operators*

OCCUPATION	NUEVA ECIJA			PANGASINAN			CAMARINES SUR		
	S	M	L	S	M	L	S	M	L
Number of farms reporting	36	47	17	27	16	2	55	11	4
					per cent				
Farmer	25	30	6	37	44	50	18	19	—
Landlord	33	19	29	15	25	50	20	18	50
Businessman	14	22	24	19	—	—	7	27	25
Govt. employee	3	2	—	4	—	—	11	9	—
Skilled worker	8	9	—	7	12	—	15	—	—
Non-skilled worker & others	3	2	—	11	—	—	4	—	—
Poultry feed dealer	—	4	29	—	13	—	—	9	—
Professional	11	6	—	—	—	—	16	9	—
None	3	6	12	7	6	—	9	9	25
Total	100	100	100	100	100	100	100	100	100

THE POULTRY ENTERPRISE

Management Practices

Characteristics of housing. The number of poultry houses per farm varied from two to 14 in Nueva Ecija; two to eight in Pangasinan; and two to four in Camarines Sur (table 6). These data did

TABLE 6.—*Characteristics of poultry housing*

ITEM	NUEVA ECIJA			PANGASINAN			CAMARINES SUR		
	S	M	L	S	M	L	S	M	L
No. of houses per farm	2	4	14	2	4	8	2	3	4[a]
Floor area per house (sq. ft.)	489	445	469	421	380	701	409	447	680
Floor space per bird (sq. ft.)	3.6	3.4	4.4	3.0	3.2	3.4	2.8	2.0	2.7
Capacity per house	135	132	107	138	122	209	152	258	256
Cost of housing material (₱)									
Per bird (capacity)	4	3	2	2	2	2	3	2	3
Per house	202	188	178	138	120	192	195	215	659
Per farm	448	829	2476	230	438	1438	301	587	2416

[a] One farm practising individual laying cages not included.

not include houses which were not being used. The floor area per house did not vary much in Nueva Ecija. Medium poultry farms in Pangasinan have relatively smaller houses than either the small or large farms. In Camarines Sur, there was a tendency for the smaller farms to have small houses, medium farms, larger houses, and large farms, the largest houses.

Placing more birds per house in Camarines Sur farms tended to reduce the floor space per bird. Except for the large farms in Nueva Ecija which had the fewest birds per house, the floor space per bird in Nueva Ecija and Pangasinan varied from 3.0 to 3.6 square feet.

The cost of housing material averaged ₱2.00 per bird for all farms in Pangasinan. In Nueva Ecija, the cost per bird ranged from ₱4.00 for small farms, to ₱3.00 for medium farms, and to ₱2.00 for large farms. The cheapest houses were found in Pangasinan which cost the medium farms ₱120. On a per farm basis, the lowest investment in housing in the small poultry farms of the same province was ₱230. However, the large farms of Camarines Sur averaged ₱2,416.

Mention may be made of one large farm in Camarines Sur which used individual laying cages. This farm had a floor space of 1.5 square feet per bird with 262 layers per house. The cost of housing per bird amounted to ₱4.00. The investment averaged ₱246 per house.

The type of housing materials used varied in each locality (table 7). This depended primarily on the availability and cost of

the materials. There was a tendency to use light materials like cogon and nipa for roof and bamboo for walls and flooring.

TABLE 7.—*Housing materials used*

MATERIALS [a]			NUEVA ECIJA			PANGASINAN			CAMARINES SUR		
			S	M	L	S	M	L	S	M	L
Number of houses			85	213	239	93	114	45	90	31	20
Roof	*Wall*	*Floor*					*per cent*				
Cogon	bamboo	bamboo	45	34	6	31	32	20	—	—	—
Cogon	mixed	bamboo	14	21	20	1	—	—	1	13	—
Nipa	bamboo	bamboo	—	1	2	28	23	51	57	35	50
Nipa	mixed	bamboo	—	1	1	1	7	—	32	23	—
G.I.	bamboo	bamboo	1	5	9	—	—	—	—	3	—
G.I.	mixed	bamboo	25	14	18	—	—	—	—	3	—
Cogon	mixed	bamboo	5	13	32	12	26	13	—	—	—
Other combinations			10	11	12	27	12	16	10	23	50
Total			100	100	100	100	100	100	100	100	100

[a] Material combinations for roof-wall-floor.
[b] One farm using individual laying cages not included.

Nipa was the most commonly used material for roofing in the large poultry farms in Camarines Sur. Aside from bamboo, farmers also used wire for walling and wood for flooring materials. These accounted for 50 per cent of the large-sized farms.

Laying houses without range predominated in Nueva Ecija and Camarines Sur (table 8). This indicated preference for raising poultry in confinement. On the other hand, Pangasinan farmers had a tendency to use ranges for their flocks. In Camarines Sur

TABLE 8.—*Poultry housing management*

TYPE OF LAYING HOUSE	NUEVA ECIJA			PANGASINAN			CAMARINES SUR		
	S	M	L	S	M	L	S	M	L
	per cent of the total number of houses								
Laying houses									
With range	6	17	24	52	69	50	—	—	25
Without range	97	86	82	56	41	50	87	73	25
Other types	—	—	—	—	—	—	13 [b]	27 [b]	50 [c]
	per cent of the total number of farms								
Laying houses									
With range	4	9	16	42	70	36	—	—	15
Without range	96	91	84	58	30	64	89	77	35
Other types	—	—	—	—	—	—	11	23	50
Total	100	100	100	100	100	100	100	100	100

[a] Laying houses with sun porches.
[b] Battery-laying houses.
[c] Battery-laying houses and individual laying cages.

farms, laying houses with sun porches, battery-laying houses, and individual laying cages were more common than ranges.

Ways and cost of starting stock. There was a marked preference for using chicks in starting the flock in the three provinces (table 9). At least three out of four farms in Nueva Ecija and all large farms in Camarines Sur preferred this method of starting the flock. In Pangasinan two out of three large farms used this method. Buying and incubating hatching eggs ranked next except for the small farms of Nueva Ecija and medium farms of Camarines Sur. This method was not too popular since the farms had to be equipped with an incubator which required additional investment for equipment.

TABLE 9.—*Ways and cost of starting stock*

STARTING STOCK	NUEVA ECIJA			PANGASINAN			CAMARINES SUR		
	S	M	L	S	M	L	S	M	L
Number of farms reporting	36	47	17	48	32	6	53	11	4
	per cent of total number of farms								
Bought and incubated breeding eggs	8	17	12	21	28	33	19	—	—
Chicks	75	81	88	81	81	67	85	91	100
Others	16 [a]	2 [b]	6 [c]	—	—	—	—	9	—
	number								
Bought & incubated breeding eggs	54	156	39	77	69	100	58	—	—
Chicks	322	368	303	218	252	95	139	193	600
Others	43 [a]	9 [b]	27 [c]	—	—	—	—	9 [c]	—
	cost (₱)								
Bought & incubated breeding eggs	11	22	7	13	16	17	10	—	—
Chicks	147	182	258	100	129	45	85	75	432
Others	279 [a]	43 [b]	189 [c]	—	—	—	—	18	—

[a] Pullets and layers.
[b] Layers.
[c] Weanlings.

In terms of per unit cost, starting the stock with layers, pullets, and weanlings required more initial capital investment than the other two methods.

Feeds and feeding. In Nueva Ecija and Pangasinan, using commercial or pre-mixed feeds was the standard practice. Except for

the medium and large farms in Pangasinan where 22 and 17 per cent respectively of the farms mixed their own feed, only a few mixed their own feed (table 10).

TABLE 10.—*Kinds of feeds used by size of farm*

KIND OF FEED	PANGASINAN			NUEVA ECIJA		
	S	M	L	S	M	L
Number of farms	36	47	17	48	32	6
	per cent of total number of farms					
Commercial (Pre-mixed)						
Brand A	42	64	76	60	50	50
Brand B	31	21	47	[a]	[a]	—
Brand C	33	19	[a]	17	—	33
Brand D	—	—	—	21	19	—
Other brands	19	22	18	14	28	33
Mixed own feeds	—	2	—	6	22	17

[a] Less than .05 per cent.

In Camarines Sur, only one large poultry farm was using commercial (or pre-mixed) feeds. All other farms mixed their own feeds.

Some farms used more than one brand. However, it is interesting to note that one brand was most popular in both Nueva Ecija and Pangasinan. This was supplied by a large feed-mixing company that had an organized distributing channel.

As a method of feeding, there was a tendency to use a combination of wet and dry mash, except in the small and medium farms of Pangasinan and small farms of Camarines Sur (table 11). In this combination feed the mash is first given dry, then wet to induce the bird to eat more of it. Subsequently, dry mash is added to the trough.

TABLE 11.—*Methods of feeding*

METHOD	NUEVA ECIJA			PANGASINAN			CAMARINES SUR		
	S	M	L	S	M	L	S	M	L
No. of farms	36	47	17	48	32	6	55	11	4
				per cent					
All mash:									
Wet	—	—	6	2	6	—	35	9	—
Dry	42	19	35	67	59	33	33	18	100
Combination	58	81	59	31	35	67	32	73	—
Total	100	100	100	100	100	100	100	100	100

Frequency of buying, source, and price of feeds. Except for the large farms, it was common for poultry raisers in Nueva Ecija and Pangasinan to buy feeds weekly (table 12a). Half of the large farms in Pangasinan and over two-thirds in Nueva Ecija bought their feeds twice a week. This was partly due to the problem of feed storage. Although the majority of the Camarines Sur farmers bought feed weekly, there was a diversity of buying frequency which ranged from every two days to monthly periods (table 12b).

TABLE 12a.—*Frequency of buying feed by size of farm*

FREQUENCY OF BUYING	NUEVA ECIJA			PANGASINAN		
	S	M	L	S	M	L
Number of farms	36	47	17	48	32	6
			per cent			
Weekly	92	66	29	77	81	50
Twice-a-week	5	34	71	21	13	50
Others	3 [a]	—	—	2 [b]	6 [c]	—
Total	100	100	100	100	100	100

[a] Every 10 days.
[b] Monthly.
[c] Every two days and monthly.

TABLE 12b.—*Frequency of buying feeds by size of farm*

FREQUENCY OF BUYING	CAMARINES SUR		
	Small	Medium	Large
Number of farms	55	11	4
		per cent	
Weekly	58	37	25
Twice a week	5	—	—
Every 2 days	2	—	25
Every 10 days	2	27	—
Monthly	—	—	25
Every 4 days	18	27	—
Every 3 days	7	—	—
Every 5 days	6	9	25
Every 6 days	2	—	—
Total	100	100	100

Egg Production

For a one-week period, all groups of farms had an average production of about four eggs per bird, except Pangasinan medium

farms which had only 3.3. The weekly production ranged from 2964 to 4266 for large farms (table 13).

TABLE 13.—*Average weekly egg production by size of farm* [a]

SIZE	NUEVA ECIJA		PANGASINAN		CAMARINES SUR	
	Per farm	Per bird	Per farm	Per bird	Per farm	Per bird
			number			
Small	512	4.2	432	3.6	420	4.4
Medium	1345	4.2	901	3.3	906	3.6
Large	4266	4.0	2964	3.6	3871	4.0

[a] Week ending: for Nueva Ecija—Jan. 17, 1958.
for Pangasinan—Dec. 20, 1957.
for Camarines Sur—April 24, 1958.

Marketing Practices

Pre-sale practices. Sizing or grading of eggs was not practised. Eggs were sold in assorted sizes. No cleaning or washing of dirty eggs was done. No pre-sale practices were done to improve the outward appearance of the eggs before they were channeled to market outlets.

Market outlets. (1) *Eggs.* Feed distributors were the favorite market outlets for eggs in Nueva Ecija and Pangasinan (table 14). In Camarines Sur nearly two out of every three farms sold eggs to retailers. Only about one-third sold eggs to feed distributors. However, Camarines Sur had the highest percentage of producers selling direct to consumer—one out of every five farms. In Nueva Ecija,

TABLE 14.—*Type of buyers of eggs*

BUYER	PER CENT OF								
	Total number of farms			Sales			Volume		
	N.E.	Pang.	C.S.	N.E.	Pang.	C.S.	N.E.	Pang.	C.S.
Feed distributor	73	65	30	63	61	21	61	51	28
Hatchery	21	—	—	16	—	—	—	16	—
Wholesale-retailer	21	7	4	14	6	2	8	31	8
Retailer	4	11	61	4	15	51	8	2	47
Consumer	3	—	21	2	—	22	c	c	12
Others	1	17 [b]	6 [a]	1	18	4	23	c	5
Total	—	—	—	100	100	100	100	100	100

[a] Wholesaler.
[b] Merchant or businessman, agent buyer and wholesaler.
[c] Less than .05 per cent.

more than one-fifth of the farms sold eggs to hatcheries. In many cases, the farms sold their eggs to several types of buyers.

In terms of the percentage of sales, about two out of three sales were handled by feed distributors in Nueva Ecija and Pangasinan. Only one out of five sales was handled by this type of outlet in Camarines Sur. However, in this province more than half of the sales went to the retailers. It may also be noted that Camarines Sur had the highest direct producer-consumer sales which averaged one out of five sales.

Volume-wise, only about half of the eggs sold went to the feed distributors in Nueva Ecija. However, the distributors still handled about two-thirds of the total in Pangasinan. One-third of the volume in Nueva Ecija went to wholesale-retailers. In Camarines Sur, a little less than half of the volume was sold to retailers and about one-third to feed distributors. Only 12 per cent of the volume went to the consumers. This indicated that although the consumer ranked second as an outlet in terms of per cent of sales, the volume they buy is relatively small. In terms of volume, other types of buyers such as agent buyers played a significant role in Pangasinan when we consider that they handled 23 per cent of the volume.

(2) *Meat.* In the sale of meat, only seven farms in Nueva Ecija, 15 farms in Pangasinan, and five farms in Camarines Sur reported meat sales (table 15). This indicated that meat production was not the major interest on poultry farms. Birds were sold on kilogram basis. On a per bird basis, the average price was ₱2.59 in Nueva Ecija, and ₱2.31 in Pangasinan. In Camarines Sur, where the only

TABLE 15.—*Market outlets and average price of meat sales* [a]

BUYER	NUEVA ECIJA		PANGASINAN	
	Number of farms reporting	Average price per bird (₱)	Number of farms reporting	Average price per bird (₱)
Number of farms	100		86	
Number of birds sold per farm	1.5		2.6	
Retailer	2	2.07	3	2.41
Consumer	2	2.97	4	2.34
Shipper	1	2.70	5	1.89
Local buyer	2	2.95	–	–
Others [b]	–	–	3	2.68
All buyers	–	2.59	–	2.31

[a] The only market outlet in Camarines Sur was the consumer.
[b] Public market, poultry raiser, and wholesale-retailer.

outlet was the consumer, the average price paid for a kilogram live weight was ₱1.59 and ₱1.14 per bird. Only four farms reported meat sales.

Prices of eggs and manner of payment by buyers. Table 16 shows the prices of eggs in the three provinces taken at different periods. These prices are, therefore, not comparable. However, prices paid by the different buyers within the provinces can be compared. For all buyers an average of ₱10.48 per hundred eggs was paid in Nueva Ecija; ₱11.60 in Pangasinan; ₱9.33 in Camarines Sur. In Nueva Ecija, the hatcheries paid the highest prices, ₱13.64. Consumers in Pangasinan and Camarines Sur paid the highest prices, the average being ₱12.10 and ₱9.85, respectively. In Pangasinan the feed distributors, who bought two-thirds of the eggs, paid ₱11.60, which ranked third in terms of prices paid by a market outlet. In Camarines Sur, the retailer and the feed distributor ranked second and third, paying ₱9.24 and ₱9.22, respectively.

TABLE 16.—*Average price of eggs paid by different types of buyer*

BUYER	NUEVA ECIJA As of Jan., 1958	PANGASINAN As of Dec., 1957	CAMARINES SUR As of April, 1958
		per hundred eggs (₱)	
Feed distributor	9.74	11.60	9.22
Hatchery	13.64	—	—
Wholesale-retailer	10.24	11.55	9.07
Retailer	10.08	11.85	9.24
Consumer	9.33	12.10	9.85
Others	10.00 [a]	11.30 [b]	9.18 [a]
All buyers	10.48	11.60	9.33

[a] Wholesaler.
[b] Agent buyer, merchant or businessman and wholesaler.

In Nueva Ecija, about three out of four farms sold some eggs for cash and two out of three exchanged them for feeds. More than half of the Pangasinan farms sold some of their eggs for cash and about three out of four exchanged them for feeds. In Camarines Sur, all the farms sold for cash and one out of five exchanged eggs for feeds. In the three provinces, the number of farms which sold their eggs on credit varied from one to three per cent. In both Nueva Ecija and Pangasinan, two per cent of the farms disposed of their eggs as payment for debts. Some farms accepted more than one method of payment.

In Nueva Ecija, half of the sales were made for cash and a little less than half in exchange for feeds. Sales on credit and payment for debts accounted for one per cent each. Over half of the Pangasinan sales were in exchange for feed and only two out of five sales were for cash. Credit and payment for debts accounted for two and one per cent, respectively. A large proportion of the Camarines Sur sales, more than four out of five, were for cash. Fourteen per cent of the sales were exchanged for feeds and only two per cent for credit. None of the Camarines Sur farmers made sales as payment for debts. This would indicate that these poultrymen had better financing in contrast with the Nueva Ecija and Pangasinan farmers who exchanged their eggs for feeds. In a great proportion of these transactions the feed distributor left the feeds with the farmer and then collected payment in terms of eggs during his next visit. The feed distributors also paid part of purchase price of eggs in cash.

TABLE 17.—*Method of paying eggs*

METHOD OF PAYMENT	PER CENT OF					
	Total number of farms			Sales		
	Nueva Ecija	Pangasinan	Cam. Sur	Nueva Ecija	Pangasinan	Cam. Sur
Cash	71	51	100	50	41	84
Exchange for feeds	68	71	19	48	56	14
Credit	2	1	3	1	2	2
Payment for debts	2	2	—	1	1	—
Total	—	—	—	100	100	100

GENERAL COMMENTS

This phase of the study indicates some problems that should receive attention from various organizations, both private and public, to improve the poultry business. Solution of these problems may mean increased net returns to the poultry raisers.

Marketing. There is a marked absence of classifying by size, cleaning or preventing loss of quality of the eggs before they are channeled into the market outlets. There is no doubt that some consumers will be willing to pay premium prices for clean and high quality eggs.

Feed distributors handled a substantial volume of the eggs sold. However, they consistently paid lower prices for eggs as market

outlets. This indicated that efforts should be exerted to channel the eggs to better market outlets.

Financing. Feed distributors usually left the feeds with the farmer and then collected payment in terms of eggs during his next visit. Sometimes they also paid part of the purchase price of eggs in cash. They are, therefore, helping to finance the poultry raisers. The cost of this financing is possibly reflected in the low prices of eggs that the farmers receive from this type of credit. On the other hand, poultrymen who sold their eggs for cash received better prices. This would indicate that the poultry raisers would be in a better position to choose their market outlets if low-cost credit would be available to help finance their farming operations.

* * *

It has become increasingly recognized that widespread support of science is essential to technological advance, economic progress, higher standards of living and to national security.

—*W. C. Foster*

DIPLODIA ROT OF MANGO

R. V. Alicbusan and L. A. Schafer

WITH THREE TEXT FIGURES

Mango, one of the best selling fruits in the Philippines, is affected by a serious disease in storage or in the market.

Repeated isolations of the causative agent from the diseased fruits consistently yielded a fungus of the genus *Diplodia*. Ruehle and Wolfenbarger [1] reported *Diplodia natalensis* as the cause of stem-end rot of mango in Florida and suggested the investigation for a direct method of control.

The surveys and interviews conducted by the writers in April, 1958, among the growers and retailers, revealed that two to 10 per cent of the mango fruits may be damaged by the disease. If the fruits are harvested after the flush of new leaves, rotting in varying degrees of severity may be found on 30 per cent of the fruits.

Symptoms. The first evidence of the disease is the appearance of violet discoloration starting from the peduncle of the ripe fruit. The lesion progresses rapidly under warm moist conditions. As the disease advances the color of the lesion changes to almost black. The affected area is soft and watery (fig. 1). The fruit may be entirely rotted within three to four days.

Infection usually starts from the peduncle or stem-end; however, bruises may also act as focal points for infection.

The organism. Elliptical spores are produced inside the pycnidia which are black, subcutaneous to erumpent and of varying shapes and sizes (fig. 2). The size of pycnidia ranges from 195 to 900 μ in length and 105 to 465 μ in width. Young spores are one-celled, hyaline and granular. Mature spores are dark brown, one-septate, and longitudinally striated. Under favorable conditions, both the young and mature spores are capable of germination (fig. 3).

Observations. Mango growers and buyers commonly use dried banana leaves as packing material in mango crates. Upon microscopic examination this material invariably revealed the presence of

[1] G. D. Ruehle and O. D. Wolfenbarger, *Rev. Appl. Mycol.*, **30**, 51, (1940).

Fig. 1.—Artificially inoculated mango fruits. On the fruit at the extreme left infection started from the bruised portion and on the two center fruits it started from the stem-end. The fruit at the extreme right is uninfected. (*Photograph taken by the Photographic Division*).

Fig. 2.—Microtome section of pycnidia (of the fruit rot fungus showing abundant pycnospores. (100×). (*Photograph taken by the Photographic Division*).

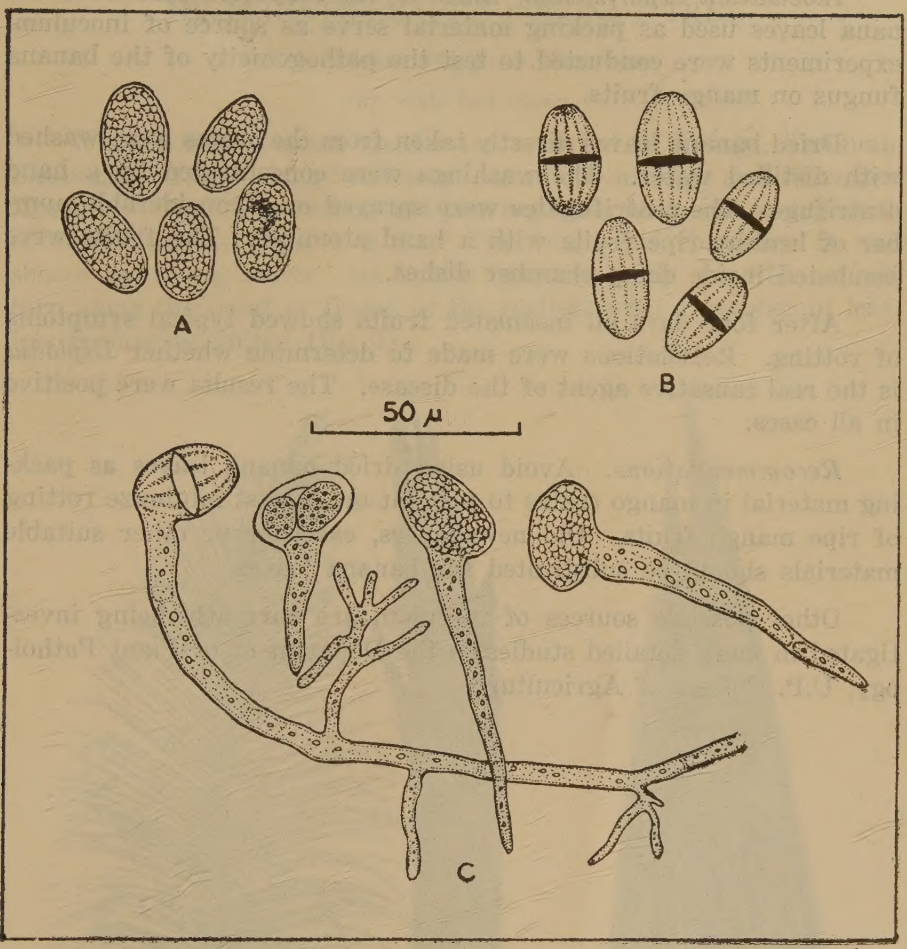

Fig. 3.—Camera lucida drawings of the causal fungus. A. Young spores. B. Mature spores. C. Germinating young and mature spores. (*Photograph taken by the Photographic Division*).

spores of a species of *Diplodia* which was subsequently proven to be pathogenic to mango fruits.

Observations in the market showed that the temperature inside the crates ranged from 31 to 34°C during the ripening period. Furthermore, a noticeable amount of moisture accumulated on the ripening fruits. This warm moist condition favors fungus growth, sporulation and infection.

Inoculation experiments. Since it was suspected that dried banana leaves used as packing material serve as source of inoculum, experiments were conducted to test the pathogenicity of the banana fungus on mango fruits.

Dried banana leaves directly taken from the crates were washed with distilled water. The washings were concentrated by a hand centrifuge. The centrifugates were sprayed on a considerable number of healthy ripe fruits with a hand atomizer. The fruits were incubated inside damp chamber dishes.

After four days all inoculated fruits showed typical symptoms of rotting. Reisolations were made to determine whether *Diplodia* is the real causative agent of the disease. The results were positive in all cases.

Recommendations. Avoid using dried banana leaves as packing material in mango crates to prevent or at least minimize rotting of ripe mango fruits. Old newspapers, excelsior or other suitable materials should be substituted for banana leaves.

Other possible sources of inoculum are currently being investigated in more detailed studies in the Department of Plant Pathology, U.P. College of Agriculture.

NOTES ON MUTANT FORMS AMONG PHILIPPINE PLANTS
III. PLICATE-LEAFED COCONUT TREE

D. L. Umali and F. A. Bernardo

WITH THREE TEXT FIGURES

Whole-leafed coconut trees were reported in Talaga, Tanauan, Batangas. They belong to Messrs. Antonio Dimayuga and Francisco Mercado. The 35-to-40-year-old bearing trees have compact growth of fused leaflets (figs. 1 & 2). The whole-leaf character is well shown by young leaves; old leaves that are badly wind-beaten are torn along the point of fusion of the leaflets with a number of leaflets remaining united (fig. 3).

Fig. 1.—Left, a normal widespreading pinnate-compound leaf from an ordinary coconut tree; right, plicate leaf from the mutant tree showing compact growth.

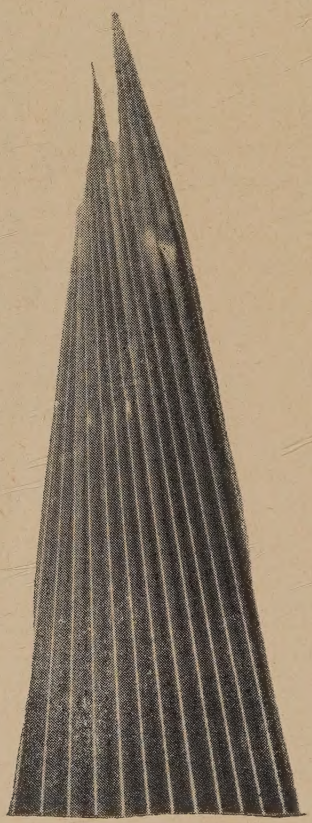

Fig. 2.—Close-up of a section of the plicate leaf showing fused leaflets.

Fig. 3.—Whole leafed coconut tree in Talaga, Tanauan, Batangas. Note the badly wind-beaten leaves and fused leaflets.

* * *

The intellectual stimulus accompanying great upheavals, however they originate, finds expression in unusual achievements in science.

—*H. A. Moe*